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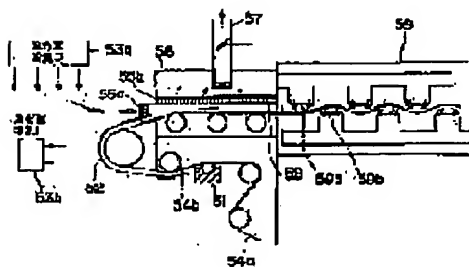
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(54) PRODUCTION OF LONG-SIZED OPTICAL COMPENSATION SHEET

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method for producing a long-sized optical compensation sheet by which an optical compensation sheet ensuring an increased angle of a visual field, causing no unevenness in an image and having a large area can be industrially and efficiently produced.

SOLUTION: In a process 51, a long-sized transparent resin film 54a with an oriented film is conveyed and the surface of the oriented film is continuously coated with a coating soln. prepd. by dissolving a liq. crystal-like discotic compd. in a solvent. In a process 56, the solvent in a formed coating layer is evaporated under control while sealing the surface of the coating layer with the layer of gas. In a process 59, the coating layer freed of most of the solvent by evaporation is converted into a discotic nematic liq. crystal layer by heating.



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CLAIMS

[Claim(s)]

[Claim 1] The process continuously applied to the orientation film front face of the long picture-like transparence resin film equipped with the orientation film which is under conveyance about the coating liquid which comes to dissolve a liquid crystallinity disothèque compound in a solvent, The manufacture approach of the long picture-like optical compensation sheet which consists of considering as the liquid crystal layer of a disothèque pneumatic phase by heating the process which evaporates a solvent under control while carrying out the seal of the front face of the formed spreading layer in a gas layer, and the spreading layer which evaporated most solvents.

[Claim 2] The manufacture approach of the long picture-like optical compensation sheet according to claim 1 to which the seal of the gas layer of the above-mentioned spreading layer front face is moved along the front face of a spreading layer so that it may become

the relative velocity of -0.1-0.1m/second to the passing speed of a spreading layer about a gas.

[Claim 3] The manufacture approach of a long picture-like optical compensation sheet according to claim 1 that the reduction rate of the content of the solvent in a spreading layer performs the process which evaporates the above-mentioned solvent under control within time amount and the period in proportionality.

[Claim 4] The manufacture approach of a long picture-like optical compensation sheet according to claim 1 that the coating liquid of this liquid crystallinity discotheque compound contains the discotheque compound 15 to 50% of the weight.

[Claim 5] The manufacture approach of the long picture-like optical compensation sheet according to claim 1 performed giving hot blast or far infrared rays to the side which does not have the liquid crystal layer of this transparence resin film for heating of this spreading layer, or by contacting a heating roller.

[Claim 6] The manufacture approach of a long picture-like optical compensation sheet according to claim 1 of performing heating after drying this spreading layer by giving hot blast or far infrared rays to both sides of this transparence resin film.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] About the manufacture approach of an optical compensation sheet, especially this invention relates to the manufacture approach of a useful optical compensation sheet, in order to improve display contrast and the viewing-angle property of a foreground color.

[0002]

[Description of the Prior Art] Generally the liquid crystal display with the big advantage of a thin shape, a light weight, and a low power is especially used as a portable word processor or a display of a personal computer to CRT (Cathode-ray tube) which is a Braun-tube mold image display device. Many of liquid crystal display components (Following LCD is called) which are carrying out current spread use the torsion nematic liquid crystal. Generally such a liquid crystal display component consists of a polarizing plate prepared in a liquid crystal cell and its both sides. The means of displaying using such liquid crystal can be divided roughly into two methods in birefringence mode and rotatory-polarization mode.

[0003] The super TSUISU Ted nematic liquid crystal which has angle of torsion and the steep electro-optics property exceeding 90 degrees is used for the super-torsion (super TSUISU Ted) nematic liquid crystal display (STN-LCD is called below) using birefringence mode. For this reason, the mass display by time-sharing drive is possible

for such STN-LCD. However, it is in yellow mode (yellowish green/navy blue) and blue mode (blue / light yellow) that practical contrast is acquired by STN-LCD, and it needed to form the phase contrast plate (a uniaxial-stretching polymer film and liquid crystal cell for compensation) for obtaining monochrome mode. In the rotatory-polarization mode which is a display mode of TN-LCD, high-speed responsibility (dozens mses) and high contrast are acquired. Therefore, rotatory-polarization mode is advantageous in many respects compared with birefringence mode or other modes. However, since TN-LCD is not equipped with the phase contrast plate like STN-LCD, it has the problem which changes with include angles in case a foreground color and display contrast look at a liquid crystal display with it being easy (angle-of-visibility property).

[0004] In order to improve the angle-of-visibility property in above-mentioned TN-LCD (namely, expansion of an angle of visibility sake), the proposal that a phase contrast plate (optical compensation sheet) is formed between the polarizing plate of a pair and a liquid crystal cell is indicated by JP,4-229828,A and JP,4-258923,A. The phase contrast plate proposed in the above-mentioned official report compensates the phase contrast which phase contrast discovers when it leans and is generated now by the liquid crystal cell although an optical operation is not given at all from the front since vertical phase contrast is about 0 to a liquid crystal cell.

[0005] It had the negative birefringence in JP,6-75115,A, JP,4-169539,A, and JP,4-276076,A, and the optical axis leans to them, and the optical compensation sheet is indicated. That is, the above-mentioned sheet is manufactured by extending polymers, such as a polycarbonate and polyester, and has the direction of the principal indices of refraction which inclined from the normal of a sheet. Since very complicated extension processing is needed in order to manufacture the above-mentioned sheet by extension processing, it is very difficult to manufacture by the approach which is having the optical compensation sheet of a large area indicated.

[0006] On the other hand, the optical compensation sheet using a liquid crystallinity polymer is also known. For example, the optical compensation sheet obtained by applying to the orientation film front face on a support film the polymer which has liquid crystallinity is indicated by JP,3-9326,A and JP,3-291601,A. However, at an elevated temperature, in order to carry out orientation of the polymer which has liquid crystallinity, since aging of long duration is required, productivity is very low and it is not fit for mass production method. Moreover, the optical compensation sheet (birefringent plate) which becomes JP,5-215921,A from the polymerization nature cylindrical compound which has a base material, liquid crystallinity, and a forward birefringence is indicated. This optical compensation sheet is obtained by the base material spreading and by carrying out heat hardening in the solution of a polymerization nature cylindrical compound. However, since the polymer which has this liquid crystallinity is optically uniaxial [forward] optically, it can hardly expand an omnidirectional angle of visibility.

[0007] Then, the optical compensation sheet with which the orientation film was formed on the transparence resin film, and the layer of a liquid crystallinity discotheque compound was formed on the orientation film as an optical compensation sheet which the omnidirectional angle of visibility expanded by the easy process is also known (EP0646829A1 public-presentation specification).

[0008] However, although it is necessary to form the layer of a liquid crystallinity

discotheque compound by uniform thickness on the film of a large area in order to create the optical compensation sheet of a large area, it is difficult to obtain such a layer by the conventional spreading and the desiccation approach. For example, the uneven orientation of uneven distribution of thickness or a liquid crystal molecule is looked at by the liquid crystal layer obtained when it dries by applying continuously the coating liquid containing a liquid crystallinity discotheque compound, and ventilating on it, making a long picture-like film (film which has the orientation film) convey, and when the optical compensation sheet which has such a liquid crystal layer is built into a liquid crystal display, there is a problem that nonuniformity occurs in the display screen.

[0009]

[Problem(s) to be Solved by the Invention] this invention person examined many things that the uneven distribution of thickness and the cause of the uneven orientation of a liquid crystal molecule which are generated in the liquid crystal layer obtained by applying continuously and drying the coating liquid which contains a liquid crystallinity discotheque compound using a wire bar spreading machine etc. should be studied. And as a result of repeating many experiments, after applying the coating liquid of a liquid crystallinity discotheque compound, the ventilation performed into the desiccation process which evaporates the solvent in a spreading layer until it heats in order to make a discotheque pneumatic phase form in liquid crystal became clear [that the above-mentioned defect will be given to a liquid crystal layer].

[0010] Therefore, the purpose of this invention is to offer the manufacture approach of a long picture-like optical compensation sheet that the optical compensation sheet of a large area which an angle of visibility is expanded and does not have image nonuniformity can be manufactured efficiently industrially, when it is used for a liquid crystal display.

[0011]

[Means for Solving the Problem] The above-mentioned purpose the coating liquid which comes to dissolve a liquid crystallinity discotheque compound in a solvent The process continuously applied to the orientation film front face of the long picture-like transparence resin film equipped with the orientation film under conveyance, By heating the process which evaporates a solvent under control while carrying out the seal of the front face of the formed spreading layer in a gas layer, and the spreading layer which evaporated most solvents It can attain by the manufacture approach of the long picture-like optical compensation sheet which consists of considering as the liquid crystal layer of a discotheque pneumatic phase.

[0012] The desirable mode of the manufacture approach of the above-mentioned optical compensation sheet is as follows.

- 1) Along the front face of a spreading layer, move the seal of the gas layer of the above-mentioned spreading layer front face so that it may become the relative velocity of -0.1-0.1m/second to the passing speed of a spreading layer about a gas.
- 2) The reduction rate of the content of the solvent in a spreading layer performs at least the process which evaporates the above-mentioned solvent under control within time amount and the period in proportionality (namely, it carries out in the part or all the range within this period).
- 3) The coating liquid of the above-mentioned liquid crystallinity discotheque compound is carrying out 15-50 weight content of the liquid crystallinity discotheque compound.

4) Carry out giving hot blast or far infrared rays to the side which does not have the liquid crystal layer of this transparence resin film for heating of a spreading layer, or by contacting a heating roller.

5) Perform heating of a spreading layer by giving hot blast or far infrared rays to both sides of this transparence resin film.

[0013]

[Embodiment of the Invention] Hereafter, this invention is explained to a detail. The manufacture approach of the optical compensation sheet of this invention has the description to evaporate a solvent under control, carrying out the seal of the front face of a spreading layer in a gas layer (generally air space), after applying to the orientation film front face the coating liquid which dissolved the liquid crystallinity disocothèque compound in the solvent, making the long picture-like transparence resin film with which the orientation film was formed convey.

[0014] The above-mentioned manufacture approach is performed from the following process.

- 1) Sending-out process of a transparence resin film;
- 2) Formation process of the resin layer for orientation film formation which applies and dries the coating liquid containing the resin for orientation film formation on the front face of a transparence resin film;
- 3) Rubbing process which performs rubbing processing to the front face of a resin layer, and forms the orientation film on a transparence resin film on the transparence resin film with which the resin layer for orientation film formation was formed in the front face;
- 4) Spreading process of the liquid crystallinity disocothèque compound which applies the coating liquid which dissolved the liquid crystallinity disocothèque compound in the solvent on the orientation film;
- 5) Desiccation process which a spreading layer is dried [process] and evaporates most solvents in this spreading layer;
- 6) Liquid crystal layer formation process which heats the dry spreading layer to disocothèque pneumatic phase formation temperature, and forms the liquid crystal layer of a disocothèque pneumatic phase;
- 7) Process which solidifies a liquid crystal layer (that is, when the liquid crystallinity disocothèque compound which quenches after the liquid crystal stratification, and is solidified, or has a cross-linking functional group is used, a liquid crystal layer is made to construct a bridge by optical exposure (or heating));
- 8) The rolling-up process which rolls round the transparence resin film with which this orientation film and a liquid crystal layer were formed.

[0015] It explains in detail, referring to a drawing. The schematic diagram of the manufacture approach of an optical compensation sheet is shown in drawing 1 and drawing 2. Transparence resin film 4a of the shape of a long picture sent out by long roll (film roll) 5a to sending-out machine 1a of a film is the process of -2 that the coating liquid which contains the resin for orientation film formation with the spreading machine 3 is applied, dry in the stoving zone 5, and a resin layer is formed on a film front face after being conveyed by the drive roll and carrying out dust removing by the surface dusting machine 2 (above 1). The obtained film may move to the following process continuously, and may once be rolled round here.

[0016] It is a process [that dust removing is carried out by the surface dusting machine 9

which the front face of the orientation film which rubbing processing was performed and was formed adjoined rubbing equipment, and was formed by the rubbing equipment which consists of a dusting machine 7 with which the rubbing roller 8, the guide idler 6 fixed to the roller stage by the spring, and the rubbing roller were equipped with transparence resin film 4b which has a resin layer for orientation film formation (above 3)]. Well-known equipments other than the above may be used for rubbing equipment. a process [that the coating liquid by which transparence resin film 4c in which the orientation film was formed was conveyed with the driving roller, and the liquid crystallinity discotheque compound was dissolved in the solvent on the orientation film is applied by the spreading machine 10 (above 4)] -- subsequently The process which heats a spreading layer to discotheque pneumatic phase formation temperature (the residual solvent of a spreading layer also evaporates here), and forms the liquid crystal layer of a discotheque pneumatic phase in the process after making it dry (above 5) (a solvent is evaporated), and the heating zone 11 (above 6).

[0017] It is the process over which ultraviolet rays are subsequently irradiated in the above-mentioned liquid crystal layer with the ultraviolet-rays (UV) lamp 12, and a liquid crystal layer constructs a bridge (above 7). In order to make a bridge construct, it is necessary to use the liquid crystallinity discotheque compound which has a cross-linking functional group as a liquid crystallinity discotheque compound. When a liquid crystallinity discotheque compound without a cross-linking functional group is used, this UV irradiation process is skipped and is cooled immediately. In this case, it is necessary to perform cooling quickly so that it may not be destroyed while a discotheque pneumatic phase cools. Inspection is conducted [whether the optical property of a transparence resin film front face is measured with test equipment 13, and the transparence resin film with which the orientation film and a liquid crystal layer were formed has trouble, and]. Subsequently, the protection film 14 laminates with the lamination machine 15 on a liquid crystal layer front face, and it is rolled round by the take-up motion.

[0018] The aforementioned process as shown in drawing 2, until it creates and rolls round an optical compensation sheet using the film roll which has the once rolled-round resin layer for orientation film formation may be continuously performed by integrated production. Film roll 5b to film 4b which has a resin layer for orientation film formation sends out, it is sent out by opportunity 1b, and the process below a rubbing process is performed like above-mentioned drawing 1.

[0019] The process of the above 1-8 may be altogether performed continuously like drawing 1, as shown in drawing 2, it may be performed in two steps, and it may perform independently the formation process, rubbing process, and liquid crystal layer formation process of a resin layer further. You may carry out by, of course subdividing further.

[0020] The process of the process (above 2) which forms the resin layer for orientation film formation on a transparence resin film is explained in detail, referring to drawing 3. The above-mentioned process can be performed as follows, for example. With a pump 32, it is sent in the extrusion die 35 which has decompression chamber 35a through a filter 33, and on the transparence resin film 34 (4a of drawing 1) conveyed, being supported with a backup roller 36, it extrudes and the coating liquid containing the resin for orientation film formation in the coating liquid tub 31 is applied from an extrusion die. 39 is a blower. Subsequently, it passes along the conveyance zone 37 which performs initial desiccation, and dries in the stoving zone 38, and the applied transparence resin

film 34 is continuously put into the next rubbing processing. Or it is once rolled round. Generally the distance of the extrusion die 35 and the transparence resin film 34 is 100-300 micrometers, and, generally 200-500Pa of decompression chambers is kept low from atmospheric pressure. A spreading rate has a desirable second in 0.1-1.0m /, and it is desirable to perform desiccation at 70-100 degrees C for 1 to 10 minutes. The viscosity of coating liquid has desirable 1 - 20 mPa-s (25 degrees C), and coverage is 10 - 50 g/m². It is desirable. Above, although applied with the extrusion die, it can carry out similarly using the wire bar used for formation of the liquid crystal layer mentioned later.

[0021] The sectional view showing the configuration of the extrusion die 35 used for formation of the above-mentioned resin layer for orientation film formation in a detail is shown in drawing 4. On the stand 42 equipped with the decompression chamber 43 which has the effluent hole 44 and an exhaust hole 45, the extrusion die 41 which has manifold 41a and slot 41b is installed. Coating liquid is supplied to manifold 41a, passes along slot 41b from here, and is applied on the transparence resin film conveyed with a backup roller 46. The include angle of the direction of slot 41b of the extrusion die 41 and a horizontal line has 30 - 50 desirable degrees, and, as for the location at the tip of the extrusion die 41, it is desirable to arrange from 5 times to the upper part caudad with the horizontal line passing through the core of a backup roller 46 in the location of 5 times.

[0022] The resin layer of the transparence resin film with which the resin layer for orientation film formation was formed is a process which carries out rubbing and forms the orientation film (above 3). Rubbing is desirable, making the transparence resin film which has the above-mentioned resin layer for orientation film formation convey continuously, as shown in said drawing 1, and it is desirable to perform a rubbing roller and dust removing of the orientation film by which rubbing was carried out in that case.

[0023] Then, the coating liquid by which the liquid crystallinity discotheque compound was dissolved in the solvent is applied to the orientation film front face of the transparence resin film with which the above-mentioned orientation film was formed. In the case of a thin layer like the spreading layer of the coating liquid of the above-mentioned liquid crystallinity discotheque compound, several seconds thru/or several minutes from immediately after sprcading Reduction of the content of the solvent in a paint film is the period (a chemical engineering lexicon, 707-712 pages, the Maruzen Co., Ltd. issue, October 25, Showa 55) which shows the constant rate of drying proportional to time amount. this invention person When a wind hit an ununiformity at this period (especially phase of immediately after spreading to the first stage) in the spreading layer of the above-mentioned liquid crystallinity discotheque compound or it was heated by the ununiformity, the thickness of a spreading layer became uneven and knowledge that nonuniformity arises in the orientation of the liquid crystal layer finally obtained was acquired. And the above-mentioned problem was solved by performing desiccation of a spreading layer, evaporating the solvent in a spreading layer under control by carrying out the seal of the front face of a spreading layer in a gas layer (generally air space).

[0024] The process of the desiccation process (above 5) of this invention of a liquid crystallinity discotheque compound drying the spreading layer of the coating liquid dissolved in the solvent, and evaporating most solvents in this spreading layer is explained in detail, referring to drawing 5. The coating liquid of a liquid crystallinity discotheque compound is applied to the orientation film front face with the wire bar spreading machine 51, conveying transparence resin film 54a in which the above-

mentioned orientation film was formed. Along with transparency resin film 54b which has the spreading layer of the applied liquid crystallinity discotheque compound, and a straightening vane 52, it is conveyed in the desiccation zone 56, and is conveyed further in the heating zone 59. However, desiccation for evaporating a residual solvent is also performed in a heating zone. In this invention, it is carried out, without applying a wind to a spreading layer as much as possible until it goes into the heating zone 59 from immediately after spreading. That is, in a desiccation process, the wind (the almost same wind speed as the bearer rate of a film, wind of wind direction) from spreading room air supplying opening 53a is introduced from wire gauze 55a of the desiccation zone 56 after passing over a straightening vane. The wind from spreading room air supplying opening 53a is exhausted from an exhaust hole 57 through wire gauze 55a to a perforated plate 58 and wire gauze 55b while it is exhausted from spreading room exhaust-port 53b. By arranging such a wire gauze and a perforated plate, the abrupt change of a wind speed and wind direction hardly happens.

[0025] The gap of a straightening vane 52 and a film has 1-10 commonmm. The die length of a straightening vane has 1-desirable 5m. The temperature of the desiccation zone 56 has desirable room temperature -50 degree C. The wind introduced into the desiccation zone 56 has common 0.3m [second] order in the location of wire gauze 55a, and, generally the bearer rate of a film is a part for 5-30m/. the above [the conditions of a desiccation zone] -- it is -- making -- what the wind whose relative velocity with the passing speed (bearer rate) of the transparency resin film which has a spreading layer at the time of desiccation is -0.1-0.1m/second is applied to a spreading layer for by things (that is, a gas layer is moved) -- it is desirable to make it like. Moreover, as coating liquid of a liquid crystallinity discotheque compound, solid content concentration is 15 - 50 % of the weight, and the thing of 1 - 20 mPa-s has the desirable viscosity of 25 degrees C. Generally it is applied at 10-40 degrees C.

[0026] The transparency resin film which ended the above-mentioned desiccation process is continuously heated by discotheque pneumatic phase formation temperature. The process of the liquid crystal layer formation process (above 6) which forms the liquid crystal layer of a discotheque pneumatic phase is explained. If stoving is performed from a spreading side side, since the front face of a spreading layer will dry first, it arranges without a surface liquid crystal molecule receiving the orientation regulation from the orientation film, and the orientation nonuniformity of a liquid crystal molecule happens as the whole layer. For this reason, hot blast blows off from the hot blast diffusers 59a and 59b formed in the both sides of a film, and he is trying for hot blast to be equivalent to the both sides of a film in the heating zone 59. It is desirable to apply hot blast from the side which does not have a spreading layer at least. Generally the range of whenever [stoving temperature] is 70-300 degrees C. It can mention contacting that hot blast or far infrared rays gives a side without the liquid crystal layer of a transparency resin film as a desirable heating means, or a heating roller etc.

[0027] The liquid crystal layer obtained as mentioned above is rapidly cooled by contacting the film which has a liquid crystal layer to air cooling or the cooled drum, when a liquid crystallinity discotheque compound without a cross-linking functional group is used. It can solidify, while this had maintained the liquid crystal phase formed in desiccation. Moreover, when the liquid crystal layer obtained as mentioned above is using the liquid crystallinity discotheque compound which has a cross-linking functional

group, a bridge is made to construct by optical exposure (preferably UV irradiation) immediately.

[0028] Expansion of the angle of visibility originating in a discotheque liquid crystal layer is not only obtained, but the optical compensation sheet obtained by the approach of manufacturing the optical compensation sheet of this invention explained above does not almost have image nonuniformity, when there is no orientation nonuniformity of liquid crystal in a liquid crystal layer and a liquid crystal display is equipped with this.

[0029] The optical compensation sheet obtained by the manufacture approach of this invention has the basic configuration which consists of a liquid crystal layer (it is also called an optical anisotropic layer) of the disco pneumatic phase formed on a transparence resin film, the orientation film prepared on it, and the orientation film. As an ingredient of the above-mentioned transparence resin film, as long as it is transparent, any ingredients can be used. The ingredient with which light transmittance has 80% or more is desirable, and when it sees especially from a transverse plane, what has the optical isotropy is desirable. Therefore, as for a transparence resin film, it is desirable to manufacture from the ingredient which has a small proper birefringence. As such an ingredient, cellulose triacetate (the example of a commercial item, ZEONEKKUSU (Nippon Zeon Co., Ltd. make), ARTON (Japan Synthetic Rubber Co., Ltd. make), and FUJITAKKU (Fuji Photo Film Co., Ltd. make)) can be used. Furthermore, even if it is a material with large rates of a proper birefringence, such as a polycarbonate, polyarylate, polysulfone, and polyether sulphone, it can obtain conditions, such as solution flow casting and melting extrusion, and by setting the letter examination of extension as length and a longitudinal direction suitably further.

[0030] When thickness of n_z and a film is set [the principal indices of refraction within the field of a transparence resin film] to d for the principal indices of refraction of n_x , n_y , and the thickness direction, respectively, it is desirable that RETADESHON to which the relation of the principal indices of refraction of three shafts is satisfied with of $n_z < n_y = n_x$ (optically uniaxial [negative]), and is expressed with formula $\{(n_x + n_y) / 2 - n_z\} \times d$ is 0nm to 300nm (preferably 30-150nm). However, if the value of n_x and n_y does not need to be strictly equal and is almost equal, it is enough. If it is $|n_x - n_y| / |n_x - n_z| \leq 0.2$, specifically, it will be satisfactory practically. | As for the transverse-plane retardation expressed with $n_x - n_y \times d$, it is desirable that it is 50nm or less, and it is still more desirable that it is 20nm or less.

[0031] Generally the orientation film is prepared on a transparence resin film. The orientation film functions as specifying the direction of orientation of a liquid crystallinity discotheque compound established on it. And this orientation gives the optical axis which inclined from the optical compensation sheet. As long as the orientation film can give a stacking tendency to an optical anisotropic layer, what kind of layer is sufficient as it. The layer to which orientation of the dielectric was carried out as a desirable example of the orientation film by grant of the layer by which rubbing processing of the organic compound (preferably polymer) was carried out, the method vacuum evaporation layer of slanting of an inorganic compound and the layer which has a micro groove, the built up film further formed of Langmuir-Blodgett's techniques (LB film), such as omega-tricosane acid, dioctadecyl methylammonium chloride, and stearyl acid methyl, electric field, or a magnetic field can be mentioned.

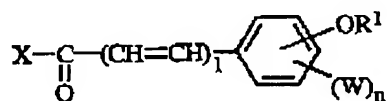
[0032] As an example of the organic compound for orientation film,

polymethylmethacrylate, an acrylic acid / methacrylic-acid copolymer, Styrene / maleimide copolymer, polyvinyl alcohol, Pori (N-methylol acrylamide), Styrene / vinyltoluene copolymer, chlorosulfonated polyethylene, A nitrocellulose, a polyvinyl chloride, chlorinated polyolefins, polyester, Compounds, such as polymers, such as polyimide, vinyl acetate / vinyl chloride copolymer, ethylene / vinyl acetate copolymer, a carboxymethyl cellulose, polyethylene, polypropylene, and a polycarbonate, and a silane coupling agent, can be mentioned. As an example of a desirable polymer, the denaturation polyvinyl alcohol which has polyimide, polystyrene, the polymer of a styrene derivative, gelatin, polyvinyl alcohol, and an alkyl group (six or more carbon atomic numbers are desirable) can be mentioned. The orientation film obtained by carrying out orientation processing of the layer of these polymers can carry out orientation of the liquid crystallinity disclike compound aslant.

[0033] In the above-mentioned polymer, polyvinyl alcohol or denaturation polyvinyl alcohol is desirable. As polyvinyl alcohol, it is the thing of 70 - 100% of saponification degrees, for example, and, generally is the thing of 80 - 100% of saponification degrees, and they are a saponification degree 85 thru/or 95% of thing more preferably. As polymerization degree, that of 100-3000 also has the desirable range. As denaturation polyvinyl alcohol, it is what carried out copolymerization denaturation (as a denaturation radical). for example, COONa, Si (OX)₃, N (CH₃)₃, and Cl and C nine H₁₉ -- COO, SO₃, Na, and C₁₂H₂₅ grade are introduced -- what denaturalized by chain transfer (as a denaturation radical) For example, the denaturation object of polyvinyl alcohol, such as what carried out denaturation by block polymerization (as a denaturation radical, COOH, CONH₂, COOR, C six H₅, etc. are introduced), with which the COONa, SH, and C₁₂H₂₅ grade is introduced can be mentioned. As polymerization degree, that of 100-3000 also has the desirable range. In these, it is un-denaturalizing [of 80 - 100% of saponification degrees] thru/or denaturation polyvinyl alcohol, and they are a saponification degree 85 95% of un-denaturalizing thru/or alkylthio denaturation polyvinyl alcohol more preferably.

[0034] As denaturation polyvinyl alcohol, it is following general formula (1): [0035] especially.

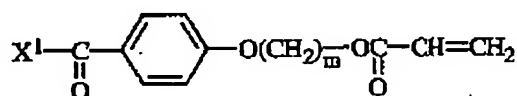
[Formula 1]
(1)



(-- however, R₁ expresses the alkyl group permuted by non-permuted an alkyl group or an acryloyl radical, a methacryloyl radical, or an epoxy group, W expresses a halogen atom, an alkyl group, or an alkoxy group, an atomic group required in order that X may form activity ester, an acid anhydride, and acid halide is expressed, and l expresses 0 or 1, and n expresses the integer of 0-4.) -- the reactant of the compound and polyvinyl alcohol which are expressed is desirable. The above-mentioned reactant (specific denaturation polyvinyl alcohol) is following general formula (2): [0036] further.

[Formula 2]

(2)

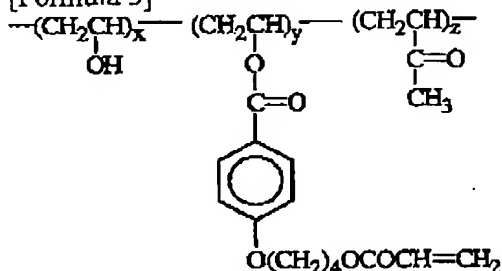


(-- however, an atomic group required in order that X1 may form activity ester, an acid anhydride, and acid halide is expressed, and m expresses the integer of 2-24.) -- the reactant of the compound and polyvinyl alcohol which are expressed is desirable.

[0037] As polyvinyl alcohol used in order to make it react with the compound expressed by the general formula (1) and general formula (2) of this invention, the denaturation object of polyvinyl alcohol, such as the polyvinyl alcohol by which denaturation is not carried out [above-mentioned] and the thing which carried out [above-mentioned] copolymerization denaturation, i.e., the thing which denaturalized by chain transfer, and a thing which carried out denaturation by block polymerization, can be mentioned. The following compound can be mentioned as a desirable example of the above-mentioned specific denaturation polyvinyl alcohol. These are indicated in detail by the Japanese-Patent-Application-No. No. 20583 [seven to] specification. Moreover, especially the following specific denaturation polyvinyl alcohol is also desirable.

[0038]

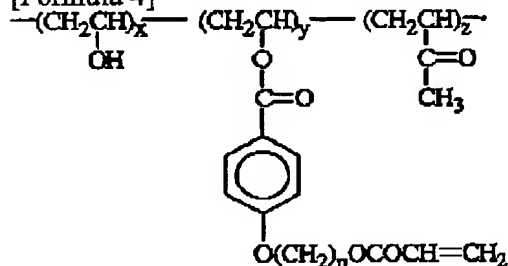
[Formula 3]



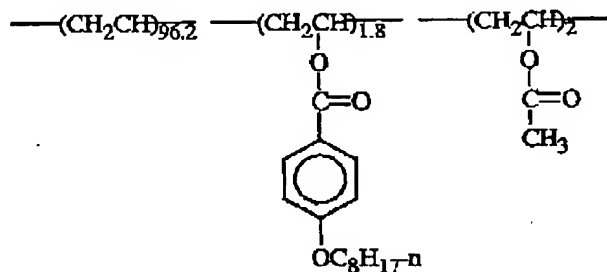
[0039] x of the above-mentioned general formula and the example of y and z (unit mol%) are shown below.

Polymer A: x= 87.2, y= 0.8, z= 12.0 polymer B: x= 88.0, y= 0.003, z= 12.0 polymer C: x= 87.86, y= 0.14, z= 12.0 polymer D: x= 87.94, y= 0.06, z= 12.0 polymer E: x= 86.9, y= 1.1, z= 12.0 polymer F: x= 98.5, y= 0.5, z=1.0 polymer G: x=97.8, y= 0.2, z=2.0 polymer H: x=96.5, y= 2.5, z=1.0 polymer I: x=94.9, y= 4.1, z= 1.0 [0040]

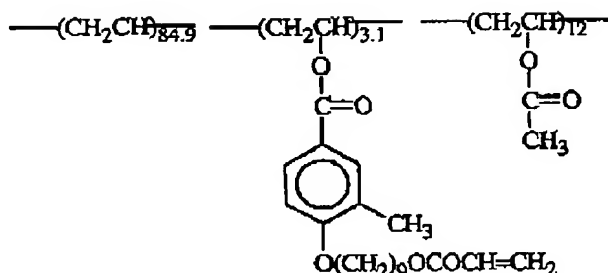
[Formula 4]



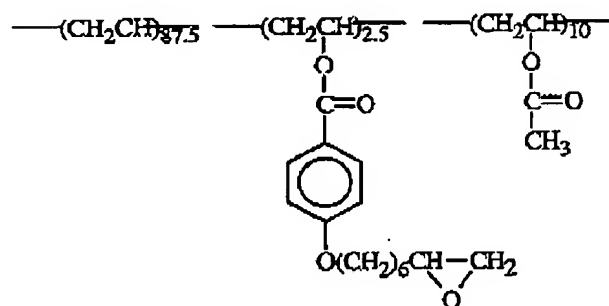
[0041] The example of nx, y, and z (unit mol%) of the above-mentioned general formula is shown below.


$$\begin{array}{c} \text{---}(\text{CH}_2\text{CH})_{84.2}\text{---}(\text{CH}_2\text{CH})_{0.8}\text{---}(\text{CH}_2\text{CH})_{13}\text{---} \\ \quad \quad \quad | \quad \quad \quad | \\ \quad \quad \quad \text{O} \quad \quad \quad \text{O} \\ \quad \quad \quad || \quad \quad \quad || \\ \quad \quad \quad \text{C}=\text{O} \quad \quad \quad \text{C}=\text{O} \\ \quad \quad \quad | \quad \quad \quad | \\ \quad \quad \quad \text{CH} \quad \quad \quad \text{CH}_3 \\ \quad \quad \quad || \\ \quad \quad \quad \text{CH} \\ \quad \quad \quad | \\ \quad \quad \quad \text{C}_6\text{H}_4 \\ \quad \quad \quad | \\ \quad \quad \quad \text{O}(\text{CH}_2)_4\text{OCOCH}=\text{CH}_2 \end{array}$$

ポリマーP



ポリマー-Q



[0047] The liquid crystal layer of the above-mentioned disco pneumatic phase is formed on the orientation film. The liquid crystal layer of this invention is a layer which is made to carry out cooling-behind orientation solidification of the liquid crystallinity

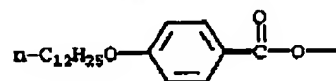
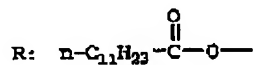
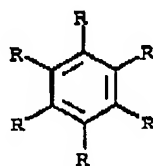
discotheque compound, or has the negative birefringence obtained by the polymerization (hardening) of the liquid crystallinity discotheque compound of polymerization nature. As an example of the above-mentioned discotheque compound C. Destrade's and others research report, Mol.Cryst., 71 volumes, The benzene derivative, C.Destrade's and others research report which are indicated by 111 pages (1981), Mol.Cryst., 122 volumes, 141 pages (1985), Physics lett., A, 78 volumes, the torr KISEN derivative indicated by 82 pages (1990), B. Kohne's and others research report, Angew.Chem.96 volume, the cyclohexane derivative indicated by 70 pages (1984), and J.M.Lehn's and others research report, J. Chem., Commun., 1794 pages (1985), J.Zhang's and others research report, J. Am.Chem.Soc., 116 volumes, an aza-crown system, a phenylacetylene system macro cycle indicated by 2655 pages (1994), etc. can be mentioned. Generally the above-mentioned discotheque (disc-like) compound makes these the mother nucleus based on molecules, it is the structure where the alkyl group of a straight chain, an alkoxy group, a permutation benzoyloxy radical, etc. were permuted in the shape of a radiation as the straight chain, liquid crystallinity is shown, and what is generally called discotheque liquid crystal is contained. However, if the molecule itself has optically uniaxial [negative] and it can give fixed orientation, it will not be limited to the above-mentioned publication. Moreover, in this invention, the object finally made as having formed from the disc-like compound does not need to be said compound, for example, it has the radical to which said low-molecular discotheque liquid crystal reacts with heat, light, etc., and a polymerization or the thing which constructed the bridge, carried out macromolecule quantification and lost liquid crystallinity is also contained by the reaction with heat, light, etc. as a result.

[0048] The desirable example of the above-mentioned discotheque compound is shown below.

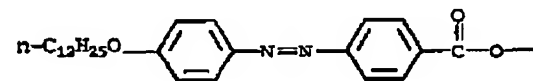
[0049]

[Formula 7]

TE-1



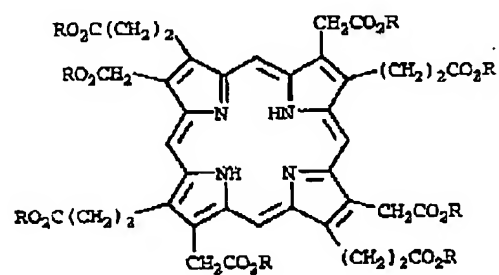
または



[0050]

[Formula 8]

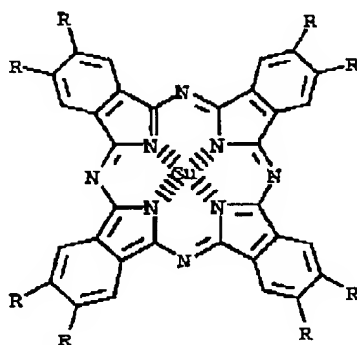
TE-2

R: $n\text{-C}_{12}\text{H}_{25}\text{—}$

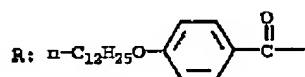
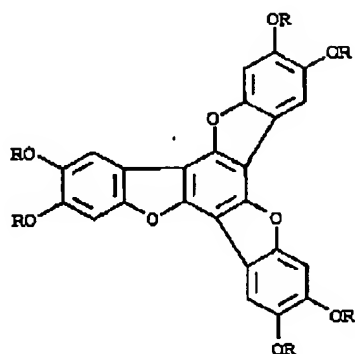
[0051]

[Formula 9]

TE-3

R: $n\text{-C}_{12}\text{H}_{25}\text{OCH}_2\text{—}$

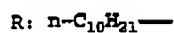
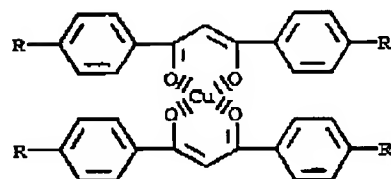
[0052]
[Formula 10]
TE-4



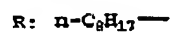
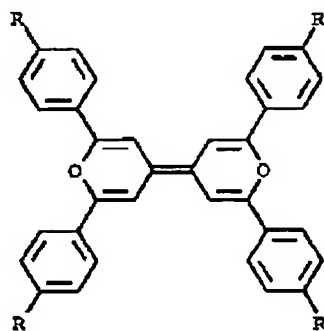
または



[0053]
[Formula 11]
TE-5



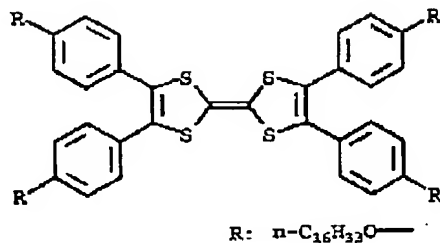
[0054]
[Formula 12]
TE-6



[0055]

[Formula 13]

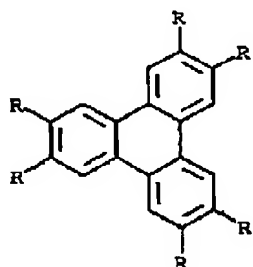
TE-7



[0056]

[Formula 14]

TE-8



R:

(1)

(2)

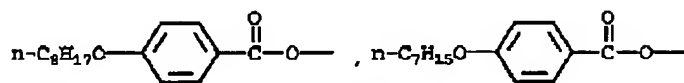
 $n\text{-C}_{m\text{H}_{2m+1}}\text{O}-$

(m = 2 - 5 の整数)

(3)

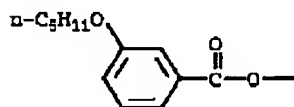
 $n\text{-C}_8\text{H}_{17}-\overset{\text{O}}{\parallel}\text{C}-\text{O}-$

(4)

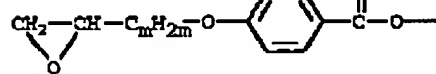
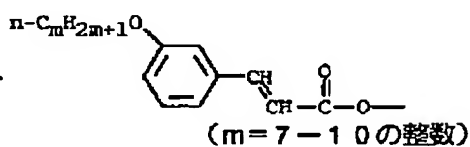


(5)

(6)

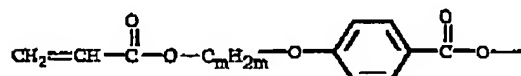


(7)



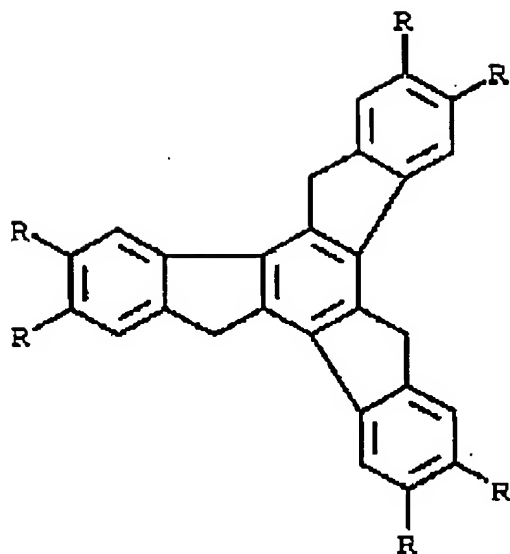
(8)

(m = 4 - 5 の整数)



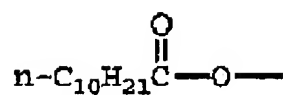
(m = 4 - 5 の整数)

[0057]
[Formula 15]
TE-9

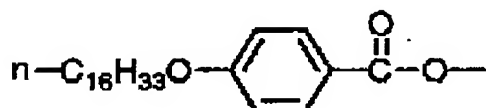


R:

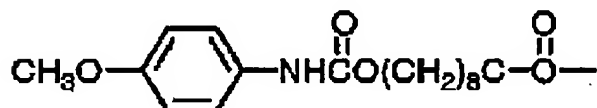
(1)



(2)



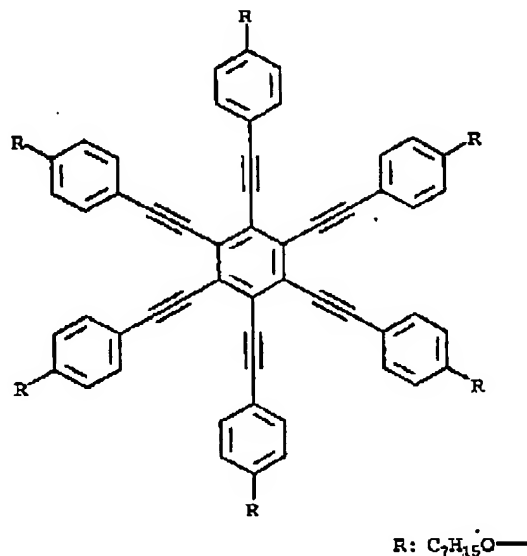
(3)



[0058]

[Formula 16]

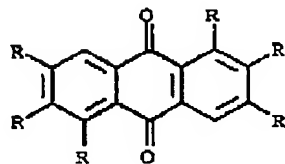
TE-10



[0059]

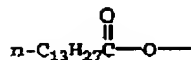
[Formula 17]

TE-11

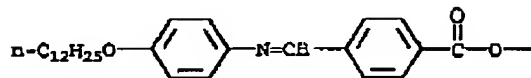


R:

(1)



(2)



[0060] Generally, on the orientation film, the liquid crystal layer of the above-mentioned disothèque pneumatic phase applies as mentioned above, dries the solution which dissolved a disothèque compound and other compounds in the solvent, subsequently heats it to disothèque nematic phase formation temperature, and is obtained by maintaining an orientation condition (disothèque nematic phase) after that, and cooling. Or the above-mentioned liquid crystal layer applies the solution which dissolved a disothèque compound and other compounds (further for example, a polymerization nature monomer, a photopolymerization initiator) in the solvent as mentioned above on

the orientation film, and it dries, and the after polymerization of the exposure of UV light etc. is carry out, and it is obtain by [which subsequently heated to discotheque nematic phase formation temperature] cool further. As a discotheque pneumatic liquid crystal phase-solid phase transition temperature of the discotheque liquid crystallinity compound used for this invention, 70-300 degrees C is desirable, and 70-170 degrees C is especially desirable.

[0061] For example, generally, the tilt angle at the time of the orientation of a base material (transparence resin film) side discotheque compound can be adjusted, choosing the ingredient of a discotheque compound or the orientation film, or when a rubbing art chooses. Moreover, the tilt angle of the discotheque unit by the side of a front face (air side) can be adjusted by choosing other compounds (an example, a plasticizer, a surfactant, a polymerization nature monomer, and polymer) generally used with a discotheque compound or a discotheque compound.

[0062] Any compounds can be used, unless it has a discotheque compound and compatibility, and it can give the tilt angle of a liquid crystallinity discotheque compound as the above-mentioned plasticizer, a surface active agent, and a polymerization nature monomer or orientation is checked. In these, a polymerization nature monomer (compound which has an example, a vinyl group, a vinyloxy radical, an acryloyl radical, and a methacryloyl radical) is desirable. Generally the above-mentioned compound is used to a discotheque compound in 1 - 50% of the weight (preferably 5 - 30 % of the weight) of an amount.

[0063] Any polymers can be used, as long as it has a discotheque compound and compatibility and a tilt angle can be given to a liquid crystallinity discotheque compound as the above-mentioned polymer. Cellulose ester can be mentioned as an example of a polymer. As a desirable example of cellulose ester, cellulose acetate, cellulose acetate propionate, hydroxypropylcellulose, and cellulose acetate butylate can be mentioned. Generally the above-mentioned polymer is used to a discotheque compound in 0.1 - 10% of the weight (preferably 0.1 - 8 % of the weight, especially 0.1 - 5 % of the weight) of an amount so that orientation of a liquid crystallinity discotheque compound may not be checked.

[0064] The coating liquid for forming the liquid crystal layer of a discotheque pneumatic phase is producible by dissolving a discotheque compound and other above-mentioned compounds in a solvent. As an example of the above-mentioned solvent, ether, such as ketones [, such as an ester; acetone, methyl ethyl ketones etc., such as alkyl halide; methyl acetate, butyl acetate, etc., such as non-polar solvent; chloroform, dichloromethanes, etc., such as polar-solvents; benzene, hexanes, etc., such as N.N-dimethylformamide (DMF), dimethyl sulfoxide (DMSO), and a pyridine], tetrahydrofuran and 1, and 2-dimethoxyethane, can be mentioned. Alkyl halide and ketones are desirable. A solvent may be independent, or it may be used, combining.

[0065] Generally the liquid crystal layer (optical anisotropic layer) of the discotheque pneumatic phase obtained by this invention has the minimum value of the absolute value of retardations other than zero in the direction to which it inclined from [of an optical compensation sheet] the normal (it does not have an optical axis). The typical example of a configuration of the optical compensation sheet containing the above-mentioned liquid crystal layer is shown in drawing 6. In drawing 6, the laminating of the transparence resin film 111, the orientation film 112, and the liquid crystal layer (optical anisotropic

layer) 113 of a discotheque phase is carried out to order, and they constitute the optical compensation sheet. R shows the direction of rubbing of the orientation film. n_1 n_2 And n_3 When the refractive index of the triaxial direction of an optical compensation sheet is expressed and it sees from a transverse plane, it is $n_1 \leq n_3 \leq n_2$. Relation is satisfied. beta is an inclination from the normal 114 of the optical anisotropic layer of a direction in which the minimum value of Re (retardation) is shown. In order to improve the angle-of-visibility property of TN-LCD and TFT-LCD, it is desirable that the direction which shows the minimum value of the absolute value of Re leans 5 to 50 degrees (average of an inclination) from the normal 44 of an optical anisotropic layer, and further 10 - 40 degrees is desirable (above beta). Furthermore, the above-mentioned sheet is following condition: $50 \leq [(n_3 + n_2) / 2 - n_1] \times D \leq 400$ (nm).

(-- condition: $100 \leq [(n_3 + n_2) / 2 - n_1] \times D \leq 400$ [however,] (nm) with desirable [D] satisfying thickness) of a sheet of further the following

[0066] The example of a typical configuration of the liquid crystal display with which the optical compensation sheet obtained by this invention was incorporated is shown in drawing 7. Optical compensation sheets [RF / RF and / 2] 1 arranged between the polarizing plates A and B of a pair, and the liquid crystal cell and polarizing plate which were prepared in the both sides of the liquid crystal cell TNC and the liquid crystal cell which consist of a nematic liquid crystal which was enclosed between the substrates and substrates of the pair equipped with the transparent electrode in drawing 7, and which could be twisted and carried out orientation And a back light BL is put together and constitutes the liquid crystal display. An optical compensation sheet may arrange only one side (namely, RF1 or RF2). R1 Optical compensation sheet RF 1 From a transverse plane, the direction of rubbing at the time of seeing is shown, and it is R2. Optical compensation sheet RF 2 The direction of rubbing is shown. The arrow head of the continuous line of liquid crystal cell TNC expresses the direction of rubbing of the substrate by the side of the polarizing plate B of a liquid crystal cell, and the arrow head of the dotted line of liquid crystal cell TNC expresses the direction of rubbing of the substrate by the side of the polarizing plate A of a liquid crystal cell. PA and PB express the polarization shaft of polarizing plates A and B, respectively.

[0067]

[Example]

Making the long picture-like film (width of face: 36cm, die-length: 300m; Fuji Photo Film Co., Ltd. make) of the triacetyl cellulose which has 100-micrometer thickness which painted the [example 1] gelatin thin film (0.1 micrometers) convey by part for 15m/, on the gelatin thin film, the coating liquid for orientation film formation which consists of the following presentation was applied with the extrusion die, as shown in drawing 3, stoving was carried out for 4 minutes at 90 degrees C, and the 0.5-micrometer spreading film was formed. As spreading conditions, the distance of the extrusion die 35 and a bright film 34 is 200 micrometers, and, generally 350Pa of decompression chambers is kept low from atmospheric pressure. The viscosity of coating liquid was 3.5 mPa-s (25 degrees C).

<Coating liquid for orientation film formation> polyvinyl alcohol derivative (said polymer A) 10 weight **** 371 weight sections methanol 119 weight sections glutaraldehyde (cross linking agent) The 0.5 weight sections [0068] Rubbing processing was performed for the obtained spreading film on condition that 15m a part for /and

rubbing engine-speed 1200rpm of film bearer rates, and film substrate conveyance tension 4 kgf/cm using the rubbing roller (diameter of 150mm), and the orientation film was formed.

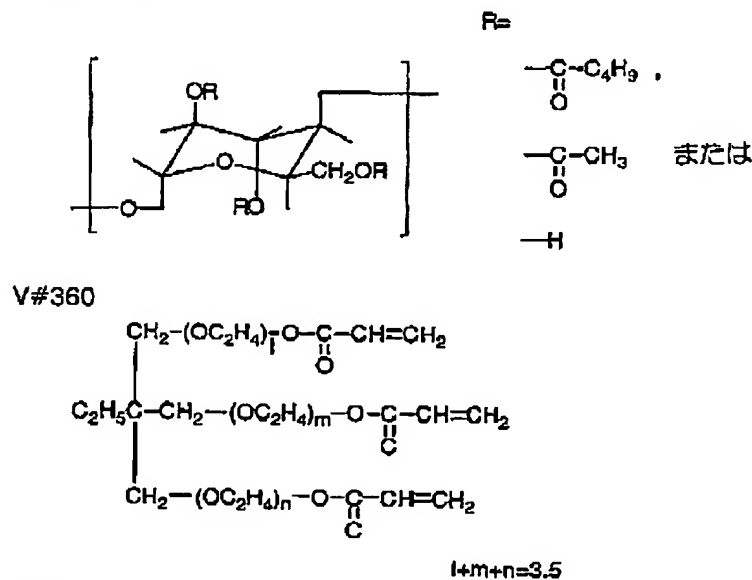
[0069] The liquid crystallinity discotheque compound TE-8 (8 m= 4) (said example number of compound) 182 weight section mentioned above, The ethylene glycol denaturation trimethylolpropane triacrylate (V#360; OSAKA ORGANIC CHEMICAL INDUSTRY, LTD. make) 18 weight section, The cellulose-acetate-butylate (CAB 551-0.2; made in Eastman Chemical) 4 weight section, The coating liquid containing the liquid crystallinity discotheque compound obtained by dissolving the photopolymerization initiator (IRUGA cure -907; Ciba-Geigy make) 6 weight section and the sensitizer (kaya KYUA DETX, Nippon Kayaku Co., Ltd. make) 2 weight section in the methyl ethyl ketone of the 343 weight sections was obtained.

[0070] The chemical structure of the above-mentioned ingredient is shown below.

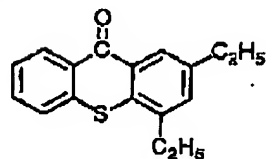
[0071]

[Formula 18]

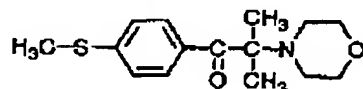
CBA551-0.2



DETX



イルガキュア 907



[0072] the desiccation and heating apparatus containing the wire bar spreading machine

which shows the coating liquid which contains the liquid crystallinity disothèque compound obtained on the orientation film front face while making the long picture-like film which has the orientation film obtained above convey to drawing 5 -- using -- spreading, desiccation, and heating -- it carried out as follows. The coating liquid (viscosity 4 mPa-s) of the liquid crystallinity disothèque compound of the above-mentioned presentation is applied to the orientation film front face with the wire bar spreading machine 51, conveying long picture-like bright film 54a in which the obtained orientation film was formed by part (0.25m/(second)) for 15m/. Along with bright film 54b which has the spreading layer of the applied liquid crystallinity disothèque compound, and a straightening vane 52, it is conveyed in the desiccation zone 56, and is conveyed further in the heating zone 89. In a desiccation process, the wind (the wind in wire-gauze 55a: the conveyance direction 0.1m [/second] wind-speed; 25 degrees C, 50%RH) from spreading room air supplying opening (5mmx450mm) 53a is introduced from wire gauze 55a of the desiccation zone 56 after passing over a straightening vane. The wind from spreading room air supplying opening 53a is exhausted from an exhaust hole 57 through wire gauze 85a to a perforated plate 58 and wire gauze 55b while it is exhausted from spreading room exhaust-port 83b. In this way, the bright film which has a spreading layer had 2m from a spreading machine to a heating zone conveyed (duration 6 seconds).

[0073] Subsequently, the 130-degree C heating zone was passed for the film with which the coating liquid which contains the above-mentioned liquid crystallinity disothèque compound on the orientation film was applied and dried in 2 minutes. Heating was performed by beginning to blow 130-degree C hot blast at a 7m [/second] wind speed from the hot blast diffusers 59a and 59b of a 2-dimensional nozzle installed in the upper and lower sides (both sides) of a film. The Ayr plate method type supporting the bright film conveyed while blowing off hot blast was used for the hot blast diffusers 59a and 59b.

[0074] Then, ultraviolet rays were irradiated with the ultraviolet ray lamp 12 (drawing 1) on the front face of a liquid crystal layer, making the film with which this orientation film and a liquid crystal layer were applied convey by part for 15m/continuously. That is, with the black light (ultraviolet ray lamp: output 120 W/cm, 1.6m of luminescence length), UV irradiation irradiated ultraviolet rays with an illuminance of 600mW for 1 second, made the liquid crystal layer construct a bridge, and obtained the long picture-like optical compensation sheet.

[0075] In the [example 2] example 1, the long picture-like optical compensation sheet was obtained like the example 1 except [which introduces the wind of a 0.25m //second / wind speed in the conveyance direction for the above-mentioned desiccation as a wind in wire gauze 55a from spreading room air supplying opening 53a] having carried out to the twist especially.

[0076] In the [example 3] example 1, the long picture-like optical compensation sheet was obtained like the example 1 except having performed the above-mentioned desiccation by [in wire gauze 55a from spreading room air supplying opening 53a] supposing the style of a wind and introducing the wind of a 0.35m [/second] wind speed in the conveyance direction.

[0077] In the [example 1 of comparison] example 1, the long picture-like optical compensation sheet was obtained like the example 1 except having performed the above-

mentioned desiccation by introducing the wind of a 0.05m [/second] wind speed in the conveyance direction as a wind in wire gauze 55a from spreading room air supplying opening 53a.

[0078] In the [example 2 of comparison] example 1, the long picture-like optical compensation sheet was obtained like the example 1 except having performed the above-mentioned desiccation by introducing the wind of a 0.40m [/second] wind speed in the conveyance direction as a wind in wire gauze 55a from spreading room air supplying opening 53a.

[0079] In the [example 3 of comparison] example 1, the long picture-like optical compensation sheet was obtained like the example 1 except having performed the above-mentioned desiccation by introducing the wind of a 0.50m [/second] wind speed in the conveyance direction as a wind in wire gauze 55a from spreading room air supplying opening 53a.

[0080] (Evaluation of an optical compensation sheet)

1) The existence of orientation nonuniformity was observed for the condition of the orientation of a liquid crystal molecule of the liquid crystal layer of the obtained optical compensation sheet using the polarization microscope.

2) The abnormality light of liquid crystal and the difference of the rate of usual state optical refraction which are shown in drawing 7, and the product of the gap size of a liquid crystal cell equipped with the above-mentioned optical compensation sheet (in the **** case, generating of a stripe used the part) the TN liquid crystal display whose angle of torsion is 87 degrees by 510nm. It equipped like RF1 and RF2 of the liquid crystal display of drawing 7, and visibility (existence [display image] of turbulence etc.) was evaluated about the obtained image. The above-mentioned result is shown in Table 1.

[0081]

[Table 1]

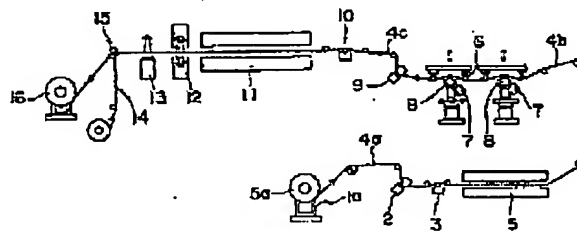
Table 1	-----	Wire gauze 55a Film Orientation nonuniformity of liquid crystal Visibility Wind which comes out (m/s) The upper wind (m/s) -----
-----	An example 1	0.15 - 0.10 Nothing The display-nonuniformity-less
example 2	0.25 0 Nothing	The display-nonuniformity-less example 3 0.35 0.10 Have no
nothing display nonuniformity.	-----	The example 1 of a
comparison 0.05 - 0.20	Those weak with nonuniformity	For a while The example 2 of the
comparison with display nonuniformity 0.40 0.15	Those weak with nonuniformity a few -	
- those with display nonuniformity -- example of comparison 3 0.500.25	Those strong	
with nonuniformity Large -----	with display nonuniformity -----	

[0082]

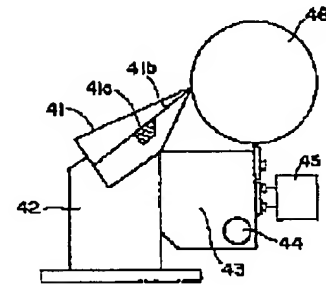
[Effect of the Invention] Expansion of the angle of visibility originating in a discotheque liquid crystal layer is not only obtained, but the optical compensation sheet obtained by the approach of manufacturing the long picture-like optical compensation sheet of this invention does not almost have image nonuniformity, when there is no orientation nonuniformity of liquid crystal in a liquid crystal layer and a liquid crystal display is equipped with this. Moreover, since the optical compensation sheet which gives a liquid crystal display without image nonuniformity can be easily obtained by the above-mentioned manufacture approach so that clearly from an example, mass production method of an optical compensation sheet can be enabled by the manufacture approach of this invention.

[Translation done.]

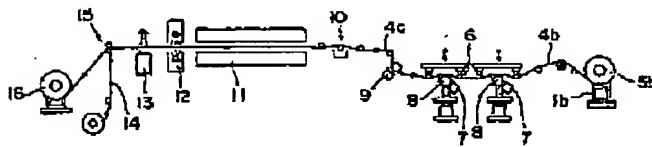
【図1】



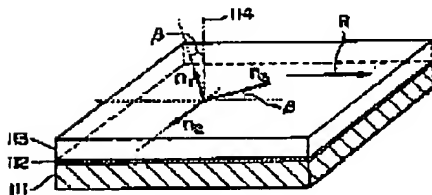
【図4】



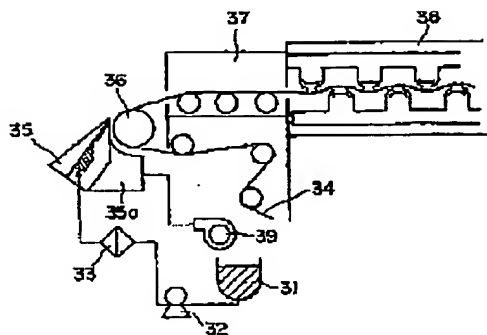
【図2】



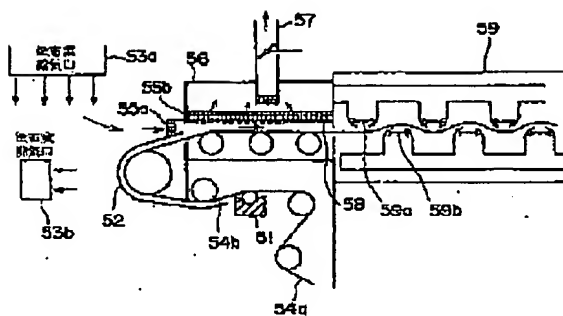
【図6】



【图3】



【图5】



【图7】

